AP Statistics
Test: Binomials and Distributions
Instructor's Version

Free Response: 3 questions, 52 points, 30 minutes

1. Blinko is a game in which three dice are rolled. To win the game, a player must roll triples — that is, three of the same number. You roll the dice 20 times.

A. Verify that the situation is binomial. (8 points)

Answer:
1. Each roll of the three dice is independent from the next.
2. The probability of success, 0.0278, is the same for each roll.
3. There is a set number of observations: 20.
4. There are only two possible outcomes: success (winning) or failure (losing).

Scoring notes: Award 2 points for each condition correctly stated.

B. Out of 20 rolls, what is the probability you win exactly 4 times? Show your work using the formula for binomial probability. (6 points)

Answer:

$$P(X=4)=\left(\frac{20}{4}\right)(0.0278)^4\ (0.9722)^{16}=4845\ (0.00000059728)(0.6369) = 0.0018$$

binompdf(20,0.0278,4)=0.0018

Scoring notes: Student must show work. If only an answer is given, only 1 point is awarded.

C. What is the probability that you win at least 3 times? (6 points)

Note: You may use the calculator to get your answer, but indicate the process you used to arrive at it. Do not use calculator notation!

Answer:
P(at least 3 wins) = 1 – P(at most 2 wins) = 1 - 0.9828 = 0.0172
Or: $P(X \geq 3) = 1 - P(X \leq 2) = 1 - 0.9828 = 0.0172$
Or: $P(X \geq 3) = P(X = 3) + P(X = 4) + \ldots + P(X = 20) = 0.0172$
1-binomcdf(20,2,.0278) = 0.0172

Scoring notes: 6 points awarded only if one of the above or similar is shown. Answer only is awarded 1 point.

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D. What is the mean number of wins in 20 rolls of the dice? (2 points)

Answer:
$\mu = np = 20(0.0278) = 0.556$

2. Jeremy decides to play the game of Blinko and is determined to play until he wins.

A. Is the situation still binomial? Explain. (4 points)

Answer:
No. It is geometric, because he will continue to play until he wins.

B. Calculate the probability of getting the first win on the third roll. (4 points)

Note: You may use either the formula or the calculator.

Answer:
Formula: $P(X = 3) = (1 - 0.0278)^{(3-1)}$ (0.0278) = 0.0263
From calculator: $P(X = 3) = 0.0263$
geometpdf(0.0278,3) = 0.0263.

C. How many times can he expect to roll the dice in order to win? (4 points)

Answer: $\mu = \frac{1}{p} = \frac{1}{0.0278} = 35.97$ rolls

Scoring notes: No partial credit is given for this problem. Student must recognize the situation as geometric and use appropriate formulas or calculator function. The answer should not be rounded since it is an expected value.

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3. Homeowners' insurance rates vary throughout the country according to a normal distribution with $\mu = 600$ and $\sigma = 75$. Suppose that FYI Insurance Company decides to conduct a review of 100 of its policies. Upon review of the 100 policies, it is found that the mean annual rate paid is $\bar{x} = 625$. Assume the 100 polices were randomly selected.

A. Calculate the mean and standard deviation of the sampling distribution of $\bar{x}$. (6 points)

Answer:

$\mu_{\bar{x}} = 600$ and $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{75}{\sqrt{100}} = 7.5$

B. What does the Central Limit Theorem reveal about the distribution of the sample? (6 points)

Answer:
The Central Limit Theorem reveals that the sample distribution will be normal for any size *n* because the parent population distribution is normal.

Scoring notes: The student should state the condition *and* make the statement about the population size for full credit. Award 3 points if only one is mentioned.

C. What is the probability that the sample mean annual insurance cost is greater than $620? Show your work. (6 points)

Answer:

$P(\bar{x} > 620) = P(z > 2.67) = 1 - 0.9962 = 0.0038$

$\frac{(620 - 600)}{7.5} = 2.67$

normalcdf(2.67,7.5) = 0.0038

Scoring notes: Student should show the above work to receive full credit. Half credit can be awarded if most of the work is shown. Award 1 point if only the answer is given.

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